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# The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

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Illuminating Engineering Society.
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*This number contains among others, articles on the following Subjects:—*

**A YEAR'S SUMMARY OF ILLUMINATING ENGINEERING** *(Continued)*

**A PROPOSED CODE ON FACTORY LIGHTING IN THE UNITED STATES** *(Continued)*

**NOTES ON LIBRARY LIGHTING.**

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THE DEVELOPMENT OF THE ELECTRIC INCANDESCENT LAMP—PRESENT PRACTICE IN THE SALE OF GAS—LIGHTING OF LONDON IN WAR TIME—REVIEWS OF BOOKS, &C.

ILLUMINATING ENGINEERING PUBLISHING COMPANY, LTD.,
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# EDITORIAL.

## An American "Code on Factory Lighting."

Almost simultaneously with the issue of the Report of the Home Office Departmental Committee on Lighting in Factories and Workshops in this country a "Code on Factory Lighting," prepared by a committee of the American Illuminating Engineering Society, has appeared. This committee has been considering the legislation of the chief States in America bearing on lighting, and the Code summarises the chief requirements of modern industrial illumination.

The issue of this Code, at the same time as the Departmental Report, is a striking recognition of the necessity for a full investigation of the subject being carried out independently in the two countries. It is also interesting to note that the Code is in general agreement with the Departmental Report, though naturally a somewhat different type of publication. It is the result of consultation on the part of a committee of experts, but is not an official Government publication preparatory to legislation.

There is therefore not the same necessity for giving detailed explanations of the technical terms used and data presented. Among the advantages of good illumination are mentioned: "Reduction of accidents, Greater accuracy of workmanship, Increased production for the same labour cost, Less eye-strain, Better working and living conditions, Greater contentment of workmen, More order and neatness in the plant, Supervision of men made easier."

We are reproducing this Code *in extenso*, and portions of it have already appeared in our last and present numbers. The values suggested for the desirable illumination are of particular interest in view of their general agreement with those specified in the Report. It should be noted that in several cases the illumination is regarded as necessary not only for safety but for enabling work to be done; the values are therefore naturally higher than those required from the standpoint of convenience and safety only. Moreover, while the values suggested in the Report are put forward as practical *legal* minima those given in the Code are presumably free from this limitation, and it is therefore possible to aim at higher values, such as an enterprising modern manufacturer would naturally desire to provide.

The Code deals with both natural and artificial illumination and makes various practical suggestions as to the best utilisation of floor-space and the location of benches with respect to the windows. Attention is drawn to the value of the upper portions of windows, on which their lighting efficiency mainly depends, and it is suggested that with a view to using this part as fully as possible blinds should be constructed to be drawn *upwards*. The importance of light walls and ceilings, for the distribution both of daylight and artificial light, also receives recognition. By artificial light, it is well known, the diffusion of rays by such light-tinted surfaces does much to diminish inconvenient shadows. In rooms lighted by side windows, the value of such diffusion, in distributing the illumination and increasing the light on desks most remote from the window, is particularly evident.

The Code refers to the tendency during recent years to make frequent use of the system of general "overhead" lighting, so as to leave the room clear and avoid as far as possible low-hanging fixtures. Now that more efficient and compact powerful illuminants are available it is practicable to produce a very strong and even illumination by this means, and general illumination is thus being applied in many cases where it would not formerly have been used. In rooms with low ceilings the advantage of being able to use lamps of high candlepower but small overall length is considerable.

Following the general remarks on factory lighting there are a number of illustrations of typical factories lighted by general, local and localised general illumination, and some examples of good and bad lighting. Finally, there is an account of methods of cleaning and maintaining lighting appliances, with a view to keeping an installation in good condition.

From this brief survey it will be evident that the Code contains a great deal of useful matter, and we commend it to the notice of our readers.

## THE NINTH ANNUAL CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY IN THE UNITED STATES.

In reading the account of the Ninth Annual Convention of the American Illuminating Engineering Society, which took place in Washington last September, one cannot help contrasting the conditions prevailing in the United States with those in Europe, plunged into the vortex of war. In this country, needless to say, the pursuit of scientific study in fields not directly connected with warfare is attended with considerable difficulties, and is naturally restricted at the present time. Many of those associated with the illuminating engineering movement are at present engaged in other fields of labour, either in the army or as advisors or assistants in Government work. Ordinary vocations must suffer, but it is our bounden duty to "keep alive the flame of scientific research" even in war time, and to maintain the machinery for doing so until happier times enable us once more to go "full steam ahead."

We are now approaching another season of the Illuminating Engineering Society in this country, and we feel sure that its supporters will do all in their power to maintain its record of useful work. Meantime we are glad to see that our friends in the United States are as actively at work as ever.

We hope in our next issue to give a fuller account of the papers read at the Convention. On this occasion we can only mention the contents of a few in order to show the wide ground covered in the discussion, and the complete manner in which theoretical investigations and practical experience are becoming linked in illuminating engineering.

It is convenient to deal with the papers in several distinct groups, namely:—(1) those concerned with the eye and visual effects of illumination; (2) those concerned with physical and photometric matters, such as colour, new instruments, and radiation; (3) those dealing with practical applications of illumination and lighting installations; (4) those dealing with miscellaneous problems.

Taking first the papers dealing with eye and visual effects, we note a communication by Cobb, describing some experiments on the effect of vision of the surroundings—a point which was brought strikingly before our notice in the discussion on the lighting of rifle ranges last May.

This matter is also discussed in a paper by Nutting, who makes the statement that in factory lighting a higher order of illumination is invariably required when the contrasts are great. Another interesting point explained by Nutting is the reason why the eye can manage with a far smaller illumination by night than is needful in the daytime. (We have had ample opportunities of testing this point personally during the last few months!) C. E. Ferree and G. Rand contribute a description of experiments on various systems of lighting, in the course of which the effect of contrast is again studied. Special interest attaches to the method of testing eye-fatigue by selecting a certain interval of time and noting the proportion of the interval during which the observer's vision of printed type is respectively "clear" and "blurred." The method is a novel one and will be studied with interest, as there seems to be a need for some convenient standard device for testing eye-fatigue.

In the second group of papers we have a contribution by W. E. Burge, who shows that the physical condition of the eye, as well as the radiation imposed on it, have a great influence on the production of cataract; these

experiments may help to explain many discrepancies that have previously been recorded by workers in this field.

Turning again to visible light, we may note Mr. Luckiesh's contribution on "yellow light." It is evident that, here again, there are many points that have not yet been experimentally settled. At present it cannot be said with certainty that yellow light is specially "easy on the eyes" or the reverse, although there is ground for thinking that the acuteness of vision by monochromatic light is greater than with a continuous spectrum. The author, for instance, approves the use of yellow-green light for targets used in rifle ranges. The greater penetrating power of the yellow and red rays seems to be well established, and Mr. Luckiesh has demonstrated their value for automobile headlights in a mist or fog.

All the above papers deal with interesting physiological points. In the photometric section we have an analysis of the requirements of illumination photometers by T. J. Litle, who raises the oft-debated question as to whether an instrument should be used to measure the current supplied to the small glow lamp; certainly such an instrument must be an exceptionally trustworthy and accurate one to be of value. Litle also discusses the test-plate, and in conjunction with C. H. Sharp describes a highly ingenious type of plate compensated to obey the cosine law strictly; the only drawback is that the plate must be observed vertically. Other contributions deal with the accuracy of standard lamps and the influence of atmospheric conditions upon their candle-power.

Among the third group of papers, which deal with practical lighting problems, there are two dealing with ship-lighting, a subject which we have always believed to offer great scope for investigation. The lighting of ships during construction is a particularly interesting point, as it is well known that accidents are apt to occur when such work is carried by night. It is interesting to note that in a busy shipyard as many as 100,000 candles are often used during the year for this purpose, but temporary electric lighting is now largely employed.

Several papers also deal with street and interior lighting. It is evident that specialists in this field are gradually feeling their way towards more scientific methods, and it will be interesting to notice what steps are taken in the United States in the near future. In this country the normal development of street illumination is naturally in abeyance owing to the restrictions imposed by the war, but it is probable that our present experiences will suggest considerable changes when progress is resumed. Of special interest at the present moment is the account of the illumination of the State, War, and Navy Department Building at Washington.

In view of the recent publication of the First Report of the Departmental Committee on the lighting of factories and workshops, R. E. Simpson's contribution on "Illumination and one year's accidents" is very timely. The author mentions a number of instances of mishaps traceable to defective lighting, and concludes by a series of diagrams showing the seasonal distribution of accidents of this type.

Finally, we may note a series of papers on miscellaneous subjects, including the applications of various illuminants to photography, the industrial uses of gas at the Panama-Pacific Exposition, and the parabolic mirror. It only remains to be said that the Convention appears to have been as successful as usual, and has again served to establish the importance of the field of work covered by the illuminating engineering movement.

LEON GASTER.

# TECHNICAL SECTION.

*The Editor while not soliciting contributions, is willing to consider the publication of original articles submitted to him, or letters intended for inclusion in the correspondence columns of "The Illuminating Engineer."*

*The Editor does not necessarily identify himself with the opinions expressed by his contributors.*

## A YEAR'S PROGRESS IN ILLUMINATING ENGINEERING.

A Report presented by the Committee on Progress (Mr. F. E. Cady, *Chairman*, Mr. T. J. Little, Mr. L. B. Marks, Mr. T. W. Rolph), at the Ninth Annual Convention of the Illuminating Engineering Society, held in Washington, September 20th to 23rd, 1915; slightly abbreviated.)

(*Continued from page* 414.)

### Arc Lamps.

A flaming arc lamp has been developed[35] in which the positive electrode is covered by an outside cylindrical layer of illuminating salts, which protect the inner electrode core against the oxygen of the air so that consumption is reduced. The electrode is of homogeneous carbon and the layer used is a mixture of calcium fluoride, sodium tungstate and potassium chromate. The negative electrode is an ordinary homogeneous carbon with a central core. The electrodes must be used vertically and are said to have a life of from 40 to 50 hours. The specific consumption including the series resistance for direct current is given as 0·14 watt per candle.

In the report of the Committee on Progress for 1913, reference was made[36] to some work on the relation of pressure and temperature in arc lamps. This work has been continued[37] and some striking results have been obtained. From these results the true temperature of the evaporating solid crater of the positive carbon at atmospheric pressure was deduced as 4,200° centigrade absolute, a value higher by 200° or 300° than that generally accepted heretofore. The temperature of the negative crater was found to be lower by several hundred degrees. If the pressure is decreased below one atmosphere the temperature of the positive crater decreases. When the atmospheric pressure is increased the temperature of the positive crater increases with a corresponding greatly increased efficiency. At a pressure of 22 atmospheres the surface brilliancy had increased to 18 times the value at one atmosphere pressure. These results were obtained with impregnated carbons, it having been found impossible to maintain a "true arc" with pure carbons at pressures greater than one atmosphere. Further experiments are to be made in

[35] *Elek. Zeit.*, Nov. 26, 1914, p. 1079.
[36] TRANS. I. E. S., Oct., 1913, p. 328.
[37] *Zeit. f. Beleu.*, Jan., 1915.

connection with the action of the impregnating salts, the dimensions of the carbons, &c.

In a study[38] of metallic arc lamps comparative tests made on ferro-ilmenite and magnetite cathodes using solid copper anodes indicate the superiority of the former. A definite dependence was found between the temperature of the arc and its most efficient length, shorter arcs being more economical at low amperages and *vice versa*. Chromium compounds exercise a cooling effect similar to that of an excessively long arc. The efficiency of the arc was increased by amounts varying from 190 to 133 per cent. by the use of a ferro-ilmenite anode. Indications were that this was due to the heat resistivity of the material, other anodes of materials with approximately the same heat resistivity such as cold rolled steel, vanadium steel and graphite giving similar favourable results.

On alternating current circuits, arcs between carbon electrodes and those between metal electrodes act quite differently owing to the low heat conductivity of carbon. The relighting potential of carbon electrodes on an alternating current circuit of 50 cycles and 3 amperes does not exceed 100 volts, but the relighting potential of metal electrodes under identical conditions is almost equal to a static discharge potential. Experiments have been made[39] using an auxiliary arc to counteract the tendency of the metal arc to cool down. Combinations were tried of carbon and ferro-ilmenite electrodes. The results indicated the possibility of using a modification of Duddell's musical-arc circuit for the purpose of sustaining the alternating ferro-ilmenite arc during the zero point in the current curve by supplying the necessary relighting potentials from the circuit itself. It is hoped a commercial alternating current metal arc may be thus developed.

An arc[40] lamp of an entirely new type is foreshadowed in a patent issued in England for an arc between tungsten or similar electrodes enclosed in a bulb containing nitrogen or other inert gas. The electrodes are horizontal and of small diameter, and the arc is struck by a simple thermo-mechanical device.

Some recent experiments on the temperature of the mercury arc as used in work on fluorescence have given results indicating values as high as 1,400° centigrade. Measurements were made on the discharge in a tube that had a platinum-iridium thermo-couple sealed into it with one junction situated at the axis of the tube. The temperature of 1,400° C. was deduced by extrapolating about 200° beyond the calibration curve of the thermo-couple. The investigation suggested that in all probability the temperatures indicated by a thermo-couple when exposed directly to the discharge are still very much below that corresponding to the mean molecular kinetic energy of the luminous vapour.

### Lamps for Projection Purposes.

*Searchlights.*—Recently the[41] United States Navy has secured a searchlight of novel form, which has already found application in Europe. This instrument is 44 inches in diameter and has instead of the usual silver mirror, a gold mirror which can be controlled automatically from a distant station. It is claimed that the use of gold gives a beam of light which is more effective in showing detail and has greater penetrating power in case of fog than that coming from a silvered mirror.

In the Swedish army an oxy-acetylene searchlight is being adopted.[42] This apparatus employs a pellet of ceria on which the oxy-acetylene flame is concentrated. The consumption is stated to be about 40 litres of acetylene and 40 litres of oxygen per hour and enough of both is carried with the instrument to provide for 20 hours burning.

A portable searchlight[43] has been developed in this country in which a 20 in. waterproof projector is used with a 750 watt focusing type non-vacuum tungsten lamp. The projector and battery weigh 600 pounds and are mounted on a two-wheeled carriage. One charge of the

[38] *Elec. Rev. and W. E.*, Apr. 10, 1915, p. 691.
[39] *Elec. Rev. and W. E.*, May 8, 1915, p. 871.
[40] *Elec. Eng.* (Lond.), May 27, 1915, p. 229.
[41] *Sci. Amer.*, Apr. 24, 1915, p. 382.
[42] *Ill. Eng.* (Lond.), Feb., 1915, p. 84.
[43] *Elec. Rlwy. Jour.*, Mar. 27, 1915, p. 639.

battery is designed to give 7 hours continuous service.

*Miner's Lamps.*—As a result of the stringent rules of the British Home Office there has been a steady development in lamps for use by miners. Six new types have been approved.[44]

The Bureau of Mines has recently revised its specifications for miner's lamps under the caption "Schedule 6-A." The principal changes are in the candlepower rating and in the uniformity test.

*Headlights.*—A big reduction in power consumption without reduction in illuminating effect[45] in street and suburban railway headlights has been made possible by the new concentrated filament tungsten lamps which are replacing arc lamps for this work.

The importance of the problem of the glaring auto-headlights which has caused so much adverse legislation and ill-feeling has been recognised[46] by the Society of Automobile Engineers as demanding immediate attention. A series of tests have been worked out which may be used as a standard definition of what constitutes a dangerous "glare" and the results of such tests will be submitted to manufacturers of headlights with a view to eliminating the trouble at the source. Future headlights are to be constructed according to scientific formulæ removing the glare but thoroughly retaining the far-reaching effect of a searchlight upon the road itself.

A new method[47] of reducing the glare from auto-headlights consists in the use of small curtains mounted on shade rollers contained in cylinders which may be attached above the lamps. The shades are raised or lowered by means of cords connected to a device operated from the driver's seat. When down they still transmit sufficient light for city driving. Another arrangement[48] consists in the mounting of two filaments in one bulb, one of 4 candlepower for city use, and one of 20 candlepower for country use. Fittings are now made[49] which enable a light to be mounted almost anywhere on an automobile, even on the wind-shield or fenders.

*Signal Lights.*—Fulfilling the forecast made in last year's report[50] semaphores are eliminated in a block signal system now being installed on one of the large railroad systems.[51] White electric lights are arranged on a black background so that the three positions of a semaphore can be imitated. Two boards corresponding to two semaphore arms are used for each track, the upper corresponding to the stop signal, the lower to the cautionary signal. These signals are used both by day and night.

The familiar oil lantern carried by train men is being displaced by an electric lantern[52] built along exactly the same lines, a dry battery being carried in the space formerly occupied by the oil, and a miniature tungsten lamp furnishing the light. Another portable lantern for railroad men consists of a nickel-plated casing,[53] the top of which carries the battery, the bottom being flared so as to act as a projector and containing an incandescent lamp. The lamp is turned on or off by the bail which is made to snap into the vertical position when being used.

Owing to reckless automobile driving the old "Stop, look and listen" signs at grade crossings are no longer as efficient as formerly in preventing accidents. In consequence one railroad has inaugurated the use[54] of large illuminated billboards to educate the public in "Safety First" and warn automobilists and others to use care in crossing tracks. A new type[55] of railroad track warning signal consists of a blackened tube containing a condensing lens behind which is a strong incandescent lamp backed up by a reflector. The tube is mounted so as to point in the direction from which the motorist will approach and the placing of the light well back in the tube makes it almost as effective by day as by night.

Street traffic controlled by means of

[44] *Elec. Eng.* (Lond.), May 6, 1915, p. 197.
[45] *Elec. Rlwy. Jour.*, Mar. 27, 1915, p. 639.
[46] *Sci. Amer.*, July 17, 1915, p. 59.
[47] *Pop. Mech.*, Mar., 1915 p. 397.
[48] *Elec. Rec.*, Apr., 1915, p. 38.
[49] *Elec. Rec.*, Feb. 5, 1915, p. 26.
[50] TRANS. I. E. S., IX, No. 6, 1914, p. 530.
[51] *Pop. Mech.*, July, 1915, p. 103.
[52] *Elec. Rec.*, May. 1915, p. 18.
[53] *Pop. Mech.*, June, 1915, p. 893.
[54] *Elec. World*, July 17, 1915, p. 146.
[55] *Tech. World*, Apr., 1915, p. 226.

signal lights described in last year's report is being tried out[56] in Pittsburgh.

There is evidence of the increased use of light as a danger signal. A power station has installed[57] a system of red lamps on the switchboard gallery which indicate when and where an individual is entering the compartments containing the dangerous high tension apparatus. Another central station uses red lights to indicate that the trolley rail of the ash conveyor is energised and therefore dangerous.

A novelty[58] in the way of a signal and projection light is a small lamp with a reflector, to be attached to an electric iron. The lamp is connected to the wiring inside the iron. It not only illuminates the cloth in front of the iron, but acts as a tell-tale in case the current is left on when the iron is not being used. Work is also being done on the development of small[59] pilot lamps for use at the needles of industrial sewing machines.

*Flashlights.*—Lately there has been an unusual development in the line of flashlights. One has been brought out exactly[60] like a fountain pen in appearance and size. It is provided with a pocket slip, is $5\frac{3}{4}$ in. (14·60 cm.) long and $\frac{3}{4}$ in. in diameter, and weighs only $1\frac{1}{2}$ ounces (42·47 gr.). A modification of this idea[61] includes a pencil holder and the lamp can be operated with or without the pencil by means of a thumb slide in the pencil barrel. Still another type[62] similar to these employs the clip as a switch and is provided with a tongue depressor for use by physicians. A flashlight has also been developed which may[63] quickly and easily be attached to an ordinary dry cell.

## War.

The great war furnishes an opportunity for the study and an incentive for the development of certain classes of illuminants. In its activity may be seen the application of the latest ideas regarding such factors as glare and the power of light of certain colours to penetrate fog. Active fighting is no more confined to daylight than business, and the old type of romantic sorties under cover of darkness are made almost impossible owing to the frequent and brilliant flashes of illumination.

A recently designed signal device consists of a pair of binoculars over which is mounted a small parallel beam flashlight. The [64]battery for lighting the lamp is carried in the belt of the user. The average range of the instrument is about 3 miles (4·82 km.). An electric flashlight apparatus used by the British is similar in size and appearance to an ordinary camera. A large lens is provided at the front of the box and flashes are made by means of a telegraph key, which closes the lamp circuit.

*Searchlights.*—Travelling searchlights have been developed by the various nations at war.[65] Automobile trucks form the carriers and supply the power. The lights may be operated either on the truck or at a distance from it. The French have brought out a device for distance control employing the response of a tuning fork at the searchlight to a vibrating current sent from a contact breaker tuned in unison with the tuning fork. Gilded mirrors are being used instead of glass. Searchlights are used not only to detect the movement of the enemy,[66] but to blind troops when they are charging across the zone of fire and to discomfort the pilots of aeroplanes. Some of those used will throw an intense light for miles. Owing to the blinding and confusing effect, it has been found to be impossible to advance a body of troops in the face of strong searchlights, a practical illustration of the use and effect of glare.

*Illuminants.*—Besides searchlights a number of other types of illuminants are being used.[67] Among these may be mentioned the luminous cartridge which serves for the illumination of nearby

[56] *Municipal Jour.*, Jan. 7, 1915, p. 12.
[57] *Elec. World*, June 12, 1915, p. 1556.
[58] *Elec. Mds.*, June, 1915, p. 165.
[59] *Elec. World*, June 12, 1915, p. 1557.
[60] *Elec. News* (Can.), Mar. 15, 1915, p. 37.
[61] *Elec. Rec.*, May, 1915, p. 18.
[62] *Elec. World*, May 15, 1915, p. 1258.
[63] *Elec. Rec.*, June, 1915, p. 21.
[64] *Sci. Amer.*, Oct. 24, 1914, p. 334.
[65] *Elec. World*, May 15, 1915, p. 1262.
*Sci. Amer. Sup.*, Oct. 3, 1914, p. 209.
[66] *Sci. Amer. Sup.*, July 10, 1915, p. 23.
[67] *Jour. f. Gas.*, May 1, 1915, p. 238.

fields and especially for investigating and exploring purposes. It is fired from its own pistol and has a range of action of about 200 metres and a luminous area of about 100 metres. It burns from 8 to 10 seconds. Similar to it, but with much larger luminous activity is the light-rocket which is discharged from a musket. It is fired distances from 45 to 900 metres and its intensity is so great that it lights up an area from 500 to 600 metres in diameter with an illumination almost as great as daylight and lasting from 30 to 40 seconds. Flares have been developed from fireworks and are similar to what are known as red, white, and blue fires used in Fourth of July celebrations. These are set out by sappers a distance in front of the battle line and are controlled from the headquarters of the officers. Ignited at intervals they keep the battle front illuminated throughout the night. Star bombs shot from mortars maintain an intense illumination for intervals as long as 20 minutes. For distance lighting a projectile similar to shrapnel is used, so constructed that it furnishes light after a definite time and at a predetermined height. Air bombs are constructed for use by aeroplanes. Torches have been developed which burn from 2 to 3 hours.

Profiting by conditions in the European war, the Secretary of War has directed the Engineering Corps to make an exhaustive study of and experiments with the use of searchlights, flares, star bombs, and other lights by troops in the field.

*Portable Lamps.*—The war has caused a considerable development in the way of pocket lamps in Germany.[68] In one type of hand lamp an ingenious mounting of the lamp in conjunction with a movable screen enables the light to be directed at various angles with the vertical and still be properly screened from observation. Another type[69] has an arrangement holding a pad and pencil with the light so concealed that only the pad is illuminated. Still another type[70] is in the form of a hemisphere, the inner surface of which is polished, and with the lamp may be used as a small searchlight.

Use is being made of acetylene for the illumination of portable hospitals.[71] Limitations in the supply of oil[72] have led in Germany to an effort to use coal gas in the lighting of trains in place of oil gas previously used. Among the other sources of light for ordinary purposes used in the war zones should be mentioned kerosene or paraffin oil lamps with incandescent mantles.[73]

*Safety Lighting.*—The danger from night raids by Zeppelins or other air craft has made it advisable to reduce the lighting in cities and towns in England and France. In Paris[74] in the neighbourhood of the Eiffel tower, lighting has been cut out almost entirely. As a sample of the orders for reduced lighting used in London may[75] be mentioned the following: In all brightly lighted streets, squares, and bridges a portion of the lights must be extinguished so as to break up all conspicuous groups or rows of lights and the lights not extinguished must be lowered in intensity, or made invisible from above by shading them or painting over the tops of the globes, providing that while thick fog prevails normal lighting may be resumed. Sky signs, illumined facias, illuminated lettering and powerful lights of all description used for outside advertising or for the illumination of shop fronts must be extinguished. Subsequently the above orders[76] were made more inclusive by prohibiting all lights outside of shops. This same order called for rear lights on vehicles. It is interesting to note that while we have had rear light ordinances for years it has taken war conditions to make the desirability of such lights apparent in London. As a result of the above requirements special reflectors have been developed.[77] In consequence of the lighting conditions it is claimed that there has been a large increase in fatalities

[68] *Elek. Zeit.*, Oct. 22, 1914, p. 1030.
*Elek. Anz.*, Mar. 28, 1915, p. 163.
*Elek. Anz.*, May 9, 1915, p. 240.
[69] *Elek. Anz.*, May 16, 1915, p. 254.
[70] *Elek. Anz.*, May 23, 1915, p. 269.

[71] *Pop. Mech.*, June, 1915, p. 829.
[72] *Acet. Jour.*, April, 1915, p. 387.
[73] *Jour. of Gas Light.*, June 15, 1915, p. 659.
[74] *Ill. Eng.* (Lond.), June, 1915, p. 289.
[75] *Jour. of Gas Light.*, Dec. 22, 1914, p. 652.
[76] *Jour. of Gas Light.*, Dec. 17, 1914, p. 637.
[77] *Elec. Times*, Dec. 31, 1914, p. 609.

caused by accidents.[78] Curious complications have arisen over the question of payment on the part of shopkeepers for exterior illumination which they are not receiving.[79]

Experiments have been made by one of the street car companies of London[80] to meet the requirements of reduced lighting and still furnish light enough to allow the passengers to read and conductors to cancel tickets. As a result of these experiments lamp shades used in the lower part of the car are dipped in a violet lacquer, thereby reducing the illumination by 50 per cent. In the upper part of the car a similar treatment is given and the shades arranged so as to throw the light across the car. The dash lights are covered over with yellow paper. Experiments on dipping the lamps themselves were found to give unsatisfactory results.

The restrictive lighting regulations have emphasised the waste occurring in many show windows[81] and the desirability of considering the principles of illuminating engineering, in order to get good results. Interesting experiments[82] are to be carried out in London to diminish the inconvenience to the public due to the low public lighting. Street curb stones are to be painted white and householders are requested to paint similarly all door steps leading from sidewalks. Not only in the field of active operations but also at home[83] the question of illumination has been a matter of vital importance in the various camps formed to take care of troops newly recruited, or en route from various parts of the country. Such camps cover an area of about 250 by 500 yards (228.6 by 457.2 m.) and contain 80 ordinary huts, 27 officers' huts, dining rooms, guard rooms, etc. About 1,200 lamps are employed.

The restrictions of lighting in so many towns in England has retarded the extensive use of the new types of high candlepower, high efficiency lamps. One of the effects of the war has been the recognition in Russia of the need of manufacturing her own incandescent lamps.[84]

[78] *Elec. Times*, May 6, 1915, p. 399.
*Ill. Eng.* (Lond.), July 1915, p. 300.
[79] *Jour. of Gas Light.*, Jan. 26, 1915, p. 182.
[80] *Elec. Ry. Jour.*, Dec. 26, 1914, p. 1398.
[81] *Elec.*, Dec. 11, 1915, p. 331.
[82] *Elec. World*, July 17, 1915, p. 158.
[83] *Elec. Eng.* (Lond.), Dec. 24, 1914, p. 649.
[84] *Elec. Rev.* (Lond.), Mar. 12, 1915, p. 634.

*(To be continued.)*

## NATIONAL ILLUMINATION COMMITTEE OF GREAT BRITAIN.

### (Affiliated to the International Commission on Illumination.)

**Constituted by Co-operation of:—**
**The Illuminating Engineering Society.**
**The Institution of Electrical Engineers.**
**The Institution of Gas Engineers.**
**The National Physical Laboratory.**

A MEETING of the National Illumination Committee of Great Britain was held at the Institution of Electrical Engineers on 20th October, 1915, when it was reported that Mr. Jacques Abady, of London, has been nominated by the Institution of Gas Engineers as a member of the Committee to fill the vacancy caused by the death of Mr. Edward Allen, of Liverpool. The Committee elected Mr. W. Duddell, of London, to be its Chairman in succession to the late Mr. Edward Allen, and Mr. John Bond, of Southport, to succeed Mr. Duddell as one of the Vice-Chairmen.

Reports on observations, carried out at the instance of the Committee at a number of technical laboratories, on the height to which the flame of the Hefner amyl acetate lamp should be raised to afford a light of one International or English standard candle, were discussed, and their further consideration was postponed until fuller details of some of the observations and other reports which had been promised had been obtained.

A report prepared and sent by Dr. E. Ott, of Zürich, on researches which had been carried out in Switzerland on the Effect of Atmospheric Pressure, Humidity and Vitiation on the Light afforded by the Hefner Standard Lamp was considered, and it was decided, subject to Dr. Ott's consent being obtained, to prepare a translation of the report for communication to the English technical Press.

# A SUGGESTED CODE OF LIGHTING FOR FACTORIES, MILLS AND OTHER WORK PLACES IN THE UNITED STATES.

(Presented at the Ninth Annual Convention of the Illuminating Engineering Society, U.S.A., held in Washington, September 20th to 24th, 1915 ; abbreviated.)

(*Continued from page* 419.)

**Section II. Value of Adequate Illumination.**—Factory and mill owners are concerned in the matter of securing the largest output for a given manufacturing expense. An improved machine tool capa le of increasing the product for given labour costs is most attractive, provided its first cost is within returnable limits out of the larger profits. Improved small tools, better methods of handling material, adequate crane service, fire protection, good shop floors, accurate and efficient time-keeping methods, and similar items, vitally concern the shop manager ; money is expended to realise excellence in these features because they afford increased economies and protection, thus resulting in a higher efficiency of the plant.

*Energy Consumption a Minor Item.*—Many arguments leading to the sale of gas and electric lamps for use in factory and mill buildings are based on reducing the lamp operation cost by substituting a new for an older system. Arguments of this kind are of value, however, only when such a reduction in operation cost can be effected without sacrifice in the adequacy of the illumination. It would be a poor policy, in the extreme, to argue a saving in energy consumption by the substitution of one type of lamp for another on a basis of equal candlepower in both old and new systems.

*Effect of Good Light on Production.*—Arguments of a convincing nature, which insure to the factory or mill manager an increased output through improved illumination service, are of importance and even greater at times than reductions in the cost of illumination for the same quantities of light. In view of the fact that resulting advantages of superior illumination on increased output are apt greatly to exceed economies in operation cost as regards the lighting system, it is a distinct advantage to direct and hold the attention on the former rather than on the la ter. This statement will be more apparent when interpreted into definite items as follows :

*Advantages of Good Light.*—While the necessity of good natural and artificial light is so evident that a list of its effects may seem commonplace, these same effects are of such great importance in their relation to factory and mill management, that they are well worth careful attention. The effects of good light, both natural and artificial, and of bright and cheerful interior surroundings, include the following items :

1. Reduction of accidents.
2. Greater accuracy in workmanship.
3. Increased production for the same labour cost.
4. Less eye strain.
5. Promote better working and living conditions.
6. Greater contentment of the workmen.
7. More order and neatness in the plant.
8. Supervision of the men made easier.

In this list it will be noted that items 4, 5, 6, 7 and 8 all have a bearing on accident prevention.

*Interpreting the Advantages of Good Light.*—While the major consideration in the eyes of the factory or mill owner is undoubtedly and quite naturally the money value of good light in the larger return of both quantity and quality of work which may result from the installation of a superior as compared with an inferior lighting system, it should be noted

that it is very difficult to interpret into dollars and cents the value of good light made possible by such returns. This difficulty is due to the necessity of keeping all conditions in a factory or mill section absolutely constant while varying the amount of illumination from poor to good conditions, in an effort to determine the output and its dependency on the lighting facilities. *As accurate data becomes available*, giving the increases in production for certain specific improvements in artificial lighting, it will doubtless prove helpful to a proper interpretation of adequate light and its worth to any plant.

The eight foregoing points are emphasised as forming the most important features in the problem of good lighting. Although difficult to interpret into money values, and somewhat intangible, they are indisputable arguments in favour of the best available illumination from the standpoint of the factory or mill owner.

*Practical Example.*—Continuing from the manufacturer's point of view, it may be said that certain assumptions as to energy cost, cleaning, interest and depreciation, show that the annual operation and maintenance cost for the illumination of a typical shop bay of 640 sq. ft. area, may be taken at $50.00. If five workmen are employed in such a bay at an average wage of say 25 cents per hour, the gross wages of the men in such a bay, plus the cost of superintendence and indirect shop expense, may equal from $5,000 to $7,000 per annum. In a case of this kind, therefore, the lighting will cost from 7/10 to 1 per cent. of the wages, or the equivalent of less than 4 to 6 minutes per day. We may roughly say that a poor lighting system will cost at least one half this amount (sometimes even more through the use of inefficient lamps and a poor arrangement of lamps), or the equivalent of say 2 to 3 minutes per day. Nearly all factories and mills have at least some artificial light, hence, in general, if good light enables a man to do better or more work to the extent of from 2 to 3 minutes per day, the installation of good lighting will easily pay for the difference between good and bad light, through the time saved for the workmen.

*Actual Losses.*—Superintendents have stated in actual instances, that due to poor light their workmen have lost much time, sometimes as much as from one to two hours per day or certain days. If good light will add an average of say one-half an hour per day to the output, these 30 additional effective minutes represent an increase in output of 5 per cent., brought about through an expenditure equal to $\frac{1}{2}$ of 1 per cent. of the wages for improved lighting, or a saving equal to ten times the expense.

*Safety.*—While these features are of special interest in the eyes of the manufacturer, the principal item to consider, perhaps, from the legislative side of the question, is the necessity of an act or acts to provide employees of workshops with proper and sufficient illumination from the standpoint of safety. The legal aspect of the safety question in its relation to illumination in factory and mill buildings, is a topic of unusual importance.

**Section III. Old and New Lamps.**—The inadequate means available for illumination by artificial methods in the past have contributed to the slowness of an appreciation of the features of artificial light which influence the working efficiency of the eye. Open flame gas burners, carbon incandescent and arc lamps, practically the only illuminants available ten years or so ago, play but a small part in the present approved methods of factory and mill lighting.

*New Lamps.*—The large variety of comparatively new lamps available for factory and mill lighting includes the mercury vapour, metallised filament, tungsten, gas filled tungsten, metallic flame or magnetic arc, the flame carbon arc, the quartz mercury vapour, and various types of gas arc lamps. Remarkable improvements have thus been made in both the electric and gas lighting fields, the same general rules of applying the lamps covering both of these fields. Possibilities in factory and mill lighting are now attainable which, before the introduction of these new lamps, were either unthought of or impossible. Consideration of the eye as a delicate organ, together with the new ideas of the items which affect its comfort and efficiency, have resulted in establishing certain principles in illumination work, and have directed attention naturally and

in a growing manner to the proper use and application of these new lamps.

**Section IV. Effects on Factory and Mill Lighting Produced by Modern Lamps.**—With the introduction of these new gas and electric lamps, broader possibilities have been presented in factory and mill lighting. The use of units of sizes adapted to the purposes, allows results which it has been hitherto impossible to obtain satisfactorily, either by the arc lamp, carbon filament or open flame gas burner, formerly available.

*New Possibilities.*—It is evident that the introduction of the many new lamps has made possible what may be termed a new era in industrial illumination, a distinctive feature of which is the scientific installation of the lighting units, suiting each to the location and class of work for which it is best adapted. Before the availability in recent years of medium sized gas and electric units the choice of the size of unit for a given location was often no choice at all. In many cases, due to small clearance between cranes and ceilings, or other conditions making it necessary to mount the lamps very high above the floor, but one size or type of unit was available, the carbon filament or open flame gas burner in the former, and the arc lamp in the latter case.

*Low Ceilings.*—For low ceilings, up to 18 ft., the use either of carbon filament, open flame gas burner, or arc lamps resulted usually in anything but uniform light over the working plane, and often produced merely a low general light which was practically useless for the individual machine. In such instances, individual lamps had to be placed over and close to the machines. With this arrangement, relatively small areas are lighted by each lamp, and the metal shades usually employed, serve only to accentuate the "spot lighting" effect. Such a form of illumination for factory and mill work is unsatisfactory and inefficient, but as stated, was in the past, in many cases, the only available scheme. *The absence of lamps of the proper size is no longer an excuse for the existence of such conditions in industrial plants.*

**Section V. General Requirements of Artificial Lighting.**—The following requirements for factory and mill lighting are made all the more important by the peculiar limitations and the wide variety of conditions to be found in factory and mill buildings and in factory and mill work:

1. Sufficient illumination should usually be provided for each workman irrespective of his position on the floor space.
2. The lamps should be installed and selected so as to avoid eye strain to the workmen.
3. The lamps should be operated from sources of supply which will insure reliable illumination results, particularly on account of the demoralising effect produced by intermittent service, just when the light may be most needed.
4. Adequate illumination should be provided from overhead lamps so that sharp shadows may be prevented as much as possible, and in such measure that individual lamps close to the work may be unnecessary except in special cases.
5. The type and size of lamp should be adapted to the particular ceiling height and class of work in question.
6. In addition to the illumination provided by overhead lamps, individual lamps should be placed close to the work if they are absolutely necessary in the eyes of a lighting expert, and in such cases the lamps should be provided with suitable opaque reflectors.

These requirements may now be met by means of the new types of gas and electric lamps, one type of which can usually be found for practically each factory and mill location, specially adapted to the general physical conditions of the location as typified by the clearance between cranes and ceiling and other similar items.

**Section VI. Overhead and Specific Methods of Artificial Lighting.**—Factory and mill lighting may be classified under two general divisions: first, distributed illumination furnished from lamps mounted overhead; and second, specific illumination furnished by individual lamps located close to the work. For practical purposes this classification is sufficient. In numerous cases a combination of these two methods becomes necessary.

*Mounting the Lamps High.*—Where the lamps are high enough to be out of the

line of ordinary vision, and are of a size and so spaced as to furnish illumination at any position of the floor where work may be carried on, the system is referred to as the *overhead method* of lighting. This method has many advantages. Its general adoption, which has been somewhat slow, has increased with the appearance of the many new types of lamps and with the growing appreciation of the value of good lighting.

Where a small amount of general or overhead lighting is coupled with specific lighting from individual lamps, a large part of the floor space in many shops is in relative darkness, and much dependence must be placed on the hand lamps close to the work. The small number of overhead lamps generally used in such cases, furnishes merely a small amount of additional illumination over the floor space which is not sufficient to be of much value. However, where sufficient intensity is provided by general illumination, this is often a very effective means of lighting a large work-room.

*Low Ceilings.*—Locations with low ceilings, until recently, have been lighted by the individual hand lamp method, because the old carbon filament lamps, being of low candlepower, could not well be used close to the ceiling, while the old type of arc lamp was often impracticable, due to its large physical size, as well as its relatively high candlepower. This statement is subject to some modification, because low candlepower units have sometimes been used in clusters for low ceilings as a compromise between a single small or a single large unit, this scheme being, however, usually insufficient and unsatisfactory in comparison with modern methods of lighting. In a particular manner, therefore, suitable illumination has been difficult with low ceilings.

New types of gas and electric lamps have a range of candlepower from very low to very high values, and the overhead system with the elimination of individual lamps is thus possible, in other words, a size of gas or electric lamp may now be selected from a large available list of sizes for nearly every factory or mill condition.

In Section VII various arrangements of lamps are discussed, and illustrated by diagrams and photographs. It is necessary to consider (1) how high lamps may be mounted; (2) are a large number of light sources needed, or may a few suffice?

With ceilings under 16 ft. high candlepower lamps can hardly be used. With ceilings higher than 25 ft. large candlepower lamps have advantages. In general a large number of small units give more even illumination and obviates inconvenient shadows, but, by careful attention to the correct positions of lamps, it is sometimes possible to reduce their number.

**Section VIII. Lighting Circuits for Electric Lamps and Supply Mains for Gas Lamps.**—The question of lighting circuits is mentioned here with particular reference to factory and mill conditions, where motor loads are apt to be large in comparison to the energy consumption of electric lamps which are in service. In some cases, the proportion of motor load to lighting load is in the ratio of 10 to 1, in others 7 to 1, and so on, and the varying demands on the circuits by motors may greatly affect the lamps. Hence it is important to maintain strictly separate supply circuits for the lamps in order to avoid varying voltage which is apt to result if the motors are connected to the same circuits with the lamps.

*Constant Voltage.*—In addition to the superior illumination resulting from lamps supplied from constant voltage mains, some types operate with longer life or very much better mechanically when supplied with constant voltage than otherwise. These features will therefore generally more than offset the somewhat greater cost of maintaining separate circuits for each class of service. In like manner and for similar reasons, it is advisable to place gas lamps on supply lines separate from those delivering gas for power purposes.

**Section IX. Control of Lamps and Arrangement of Switches.**—The control of lamps in factory and mill lighting is important in all cases, but specially so where a large number of lamps is used in preference to a small number for a given floor area. For example, where an overhead system of tungsten lamps of small size is used, a large number will, of course, be necessary for a given floor area, and in

such cases the number of control circuits may at times seem excessive when planned out for sufficient flexibility of operation. Such circuits, however, in rendering the system more flexible, will be more than paid for by the saving in energy and maintenance due to the turning out of lamps not needed in certain sections of the factory or mill, provided the number of hours per day during which the lamps are used on the average is relatively large, and the differences in daylight intensities over the floor area is also relatively large.

*Control Parallel to Windows.*—The lamps most distant from the windows will usually be required at times when the natural light near the windows is entirely adequate, thus making it an advantage to arrange the groups of lamps in circuits parallel to the windows. The advantage of this method is further apparent when it is considered that if the lamps are controlled in rows perpendicular to the windows, all lamps in a row will necessarily be on at one time, while a portion only may be required.

*Practical Case.*—The foregoing statement may be developed into a definite proposition. Thus, to install a single switch may involve say $5.00 as its first cost. If ten lamps are to be controlled from a single switch, these ten lamps must obviously either all be turned off at a time or all turned on at a time. An additional switch at a cost of $5.00 will permit either half of these ten lamps being turned off, if not required at certain times when the remaining five are needed. This extra switch may or may not be an economy. Consider, for example, the case where these five lamps are of the 60-watt tungsten type, and that they are turned off by the extra switch on an average of one-half an hour per day while the others are needed, or *vice versa*. In a year's time, the energy saved at 1 cent per kilowatt-hour, will amount to perhaps 50 cents. At this rate it will require ten years for the energy saved to pay for the first cost of the extra switch. This would not be considered a distinct economy. If, however, the energy cost be greater, and more nearly the average under actual conditions, or if the number of hours per day during which a portion only of the lamps will not be used, be greater, then these values will be correspondingly modified.

*Locating Switches and Controls.*—In locating switches or controls in factory and mill aisles, care should be exercised to arrange them systematically, that is, on columns situated on the same side of the aisle and on the same relative side of each column. This plan materially simplifies the finding of switches or controls, by those responsible for turning on and off the lamps, and is particularly important where a given floor space is illuminated by a large number of small or medium sized lamps distributed uniformly over the ceiling area, a feature which is usually accompanied by the use of a relatively large number of switches or controls.

**Section X. Systematic Procedure Should be followed in Changing a Poor Lighting System Over to an Improved Arrangement.**—When undertaking the change from an old to a new lighting system, the various forms of illumination which are adapted to factory and mill spaces should be studied, and an investigation made of the various types of gas and electric lamps on the market which are available for the purpose.

Time should be allowed for a study of the given locations to be lighted; for preparing the plans of procedure in the installation of the gas or electric lamps and auxiliaries; and for customary delays in the receipt of the necessary supplies and accessories to the work in hand. Altogether, therefore, work of this kind requires considerable time for its completion.

(*To be continued.*)

## THE DEVELOPMENT OF THE ELECTRIC INCANDESCENT LAMP DURING THIRTY-FIVE YEARS.

AN interesting article in the *Electrical World* for October 16th traces the development of lamp sales in the United States since Edison's discovery. Regular manufacture, it is stated, began at Menlo Park, N.J., in 1880, when 25,000 lamps were made. In the following year the production was increased to 30,000. Thirty years later the output of lamps in the United States had reached the enormous figure of 80,000,000. Progress is shown graphically in Fig. 1 and Fig. 2, which also indicate the gradual transition from carbon to metal filaments from 1907 at the present day. Equally striking are the diminution in the price of lamps and the steady gain in efficiency.

The following figures are interesting as showing the percentage of total sales of the chief standard sizes of lamps :—

| | 1913. | 1914. |
|---|---|---|
| 25 watt .. .. | 29·34 | 26·78 |
| 40 watt .. .. | 27·11 | 26·32 |
| 60 watt .. .. | 15·08 | 16·72 |
| 100 watt .. .. | 5·72 | 5·80 |

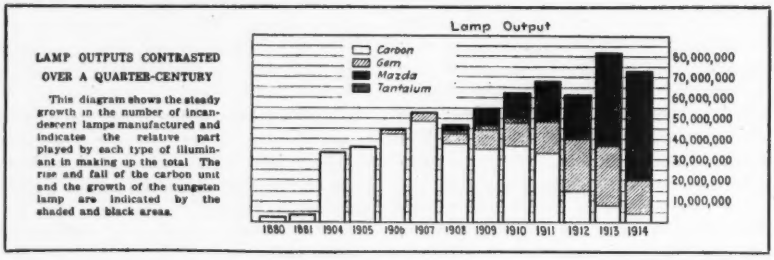

LAMP OUTPUTS CONTRASTED OVER A QUARTER-CENTURY
This diagram shows the steady growth in the number of incandescent lamps manufactured and indicates the relative part played by each type of illuminant in making up the total. The rise and fall of the carbon unit and the growth of the tungsten lamp are indicated by the shaded and black areas.
Lamp Output
Carbon
Gem
Mazda
Tantalum
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
1880 1881 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914

FIG. 1.

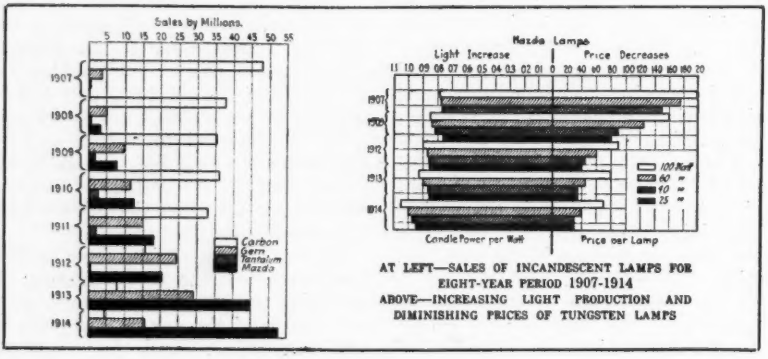



FIG. 2.

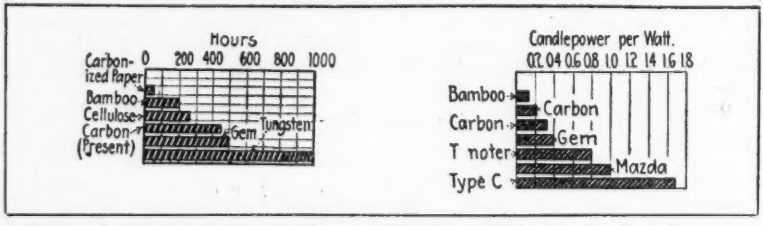



FIG. 3.—Comparisons of burning hours and luminous efficiencies of early carbon and modern incandescent units.

The problem of obtaining a similar record of sales in this country is doubtless more difficult. It would, however, be a useful piece of work of great interest to the lighting industry, and the leading lamp companies might well take the matter in hand.

## DAYLIGHT ILLUMINATION IN THE SCHOOLROOM.

THE following paragraph, which is taken from the Report of the Medical Officer of Health (Dr. I. D. Jenkins), Rhondda Education Authority, 1914, illustrates the special difficulties met with in some localities in the natural lighting of schoolrooms. The school is evidently situated in a hilly district, and the windows are overlooked to a considerable extent.

"With a few noticeable exceptions a sufficiency of light is admitted by means of windows into the classrooms of the schools. In many instances, however, the direction from which the light enters in relation to the position of the desks and blackboards is faulty, and apparently incapable of being remedied without material structural alterations. In some of the schools the use of artificial light—usually coal gas, sometimes electric light—is necessary before the dismissal of the children owing to the extent to which the windows are overlooked by erections or adjacent hills. In other instances again the appropriate and full use of the windows is rendered impossible by the extent to which some of the glass, especially in the upper panes, is obscured by dust which has been allowed to accumulate undisturbed for considerable periods owing, usually, to the inability of the female cleaners often employed to reach these positions without undue personal risk."

In view of the importance of the light received from the upper portion of the windows the accumulation of dust on this part of the glass, as mentioned in the Report, is particularly disadvantageous.

School authorities may be recommended to pay special attention to this point.

## ILLUMINATING ENGINEERING SOCIETY (U.S.A.).

### ANOTHER SERIES OF LECTURES AT THE JOHNS HOPKINS UNIVERSITY CONTEMPLATED.

A MEETING of the Council of the Illuminating Engineering Society was held, October 14th, in the general offices of the Society, 29, West 39th Street, New York, N.Y.

After considering the appointments to various committees for the present year, preliminary plans were discussed for the holding of a semi-annual convention in New York next February to mark the tenth anniversary of the organisation of the Society.

It was also planned to arrange for the presentation of a course of lectures on illuminating engineering similar to the course which was given in the autumn of 1910 at the Johns Hopkins University under the auspices of the Society. The programs of papers and meetings for the various sections of the Society were read and discussed briefly by the vice-presidents representing the various sections of the Society. Those present at the meeting were: President Charles P. Steinmetz, H. Calvert, Wm. A. Durgin, Clarence L. Law, M. Luckiesh, A. S. McAllister, L. B. Marks, Treasurer, J. Arnold Norcross, and G. H. Stickney.

## PRESENT PRACTICE IN THE SALE OF GAS IN THE UNITED KINGDOM.

By F. W. Goodenough.*

In this paper Mr. F. W. Goodenough summarised the enterprising steps that have been taken during recent years to develop the gas industry in this country. Particular interest attaches to his account of the methods adopted to secure the goodwill of the consumer and lead him to recognise that the company is aiding him to make the best use of the illuminant—a policy which every up-to-date company should adopt in these days.

### Co-operation with the Public.

Effective salesmanship in the gas industry, Mr. Goodenough remarks, involves the recognition of the following facts :—

(1) If you want every consumer to use as much gas as he can consume with profit or advantage to himself you must make it easy for him to get an adequate and constant supply, and to get the most efficient appliances for its use. Then you must see that his appliances are kept constantly in efficient order.

(2) If you don't tell every consumer what you and your commodity are willing and able to do for him he very likely won't know.

(3) If you want to consolidate your business on the surest foundation you must get it fixed in the minds of every one of your employees that the consumers' interests and those of the business are parallel and not opposite; and your whole policy of dealing with the public—whether it be in giving advice, in rendering service, in receiving and dealing with complaints, or in settling disputes—must be based upon a conviction of that truth.

A policy founded upon these facts necessarily implies :—

(*a*) The laying of adequate mains, the installation of capacious carcass pipes, and the maintenance of a good and steady pressure; the provision of slot meters for the poorer class of consumer; easy terms for the supply and fixing of apparatus; well equipped showrooms in suitable positions staffed with trained salesmen and women; an efficient fitting staff; an equally efficient maintenance staff; reasonable maintenance terms.

(*b*) Effective publicity, including local, district and national press advertising; expert canvassing; lectures, both domestic and scientific; good public and store front lighting.

(*c*) The provision and training of a good commercial and administrative staff imbued with "the spirit of the house" right down from the chairman of the board to the telephone operator, the office boy and the doorkeeper.

### Adequate Pressure.

Among other points of importance are the maintenance of a good and steady pressure. Present practice tends towards the use of much higher pressures than were available in the old flat flame days: 30 or 40 tenths is now a common pressure at the meter, and in these circumstances a variation of 3 or 4 tenths is a much less noticeable matter than if the pressure ranged about 15 tenths.

### Improved Gas Fittings.

Mr. Goodenough also points out the improvement which is now taking place in the design of fittings :—

Great improvement has taken place in recent years in the design and construction of gas appliances, especially inverted burner lamps for both high and low pressure, gas fires and water heaters. The leading manufacturers are expending considerable sums of money on laboratory research and testing work, and some gas managers stimulate this by themselves applying stringent tests to any lighting or fuel apparatus submitted before accepting it as suitable for sale or hire to the public. The setting-up of a high standard in this way by those gas undertakings which can afford to run laboratories and employ scientific examiners of apparatus benefits the whole industry by raising the quality of all goods produced. Fortunately the gas fittings and apparatus makers of to-day realise more fully than ever the importance of ensuring high efficiency and scientific construction in all appliances for the consumption of gas; and all but the "back number" gas managers realise that the most economical and efficient burner, stove or furnace, and not that which is wasteful of gas, is their best friend in the long run.

The equipment of attractive showrooms is becoming thoroughly appreciated by British gas enterprises. In this country there is a steady improvement in the showrooms, and demonstrations and lectures form now a common feature. It has also been found that there is an important field for lady advisers, who are naturally able to appreciate many points in connection with the domestic use of gas and to bring these home to consumers.

### Maintenance of Gas Appliances.

Many companies have now taken upon themselves the task of supplying, fixing

* Abstract of Paper presented before the International Gas Congress, held in San Francisco, Sept., 1915.

and maintaining all kinds of gas appliances for lighting, heating and cooking, so that the provision of a competent fittings and maintenance staff is quite an important problem. As is well known, a scheme was instituted by Sir Corbet Woodall some years ago for the training of competent fitters and members of the sales department. Under the auspices of the Institution of Gas Engineers annual examinations are now held by the City and Guilds of London Institute, and courses of apprenticeship have been organised for boys taken direct from the London County Council Schools.

The following account of the methods adopted in the maintenance of burners and apparatus will be of interest to many of our readers :—

The need for maintenance to follow upon installations of gas appliances is becoming generally recognised in this country. That recognition has first of all taken the shape of the establishment of arrangements for the periodical cleaning and remantling of consumers' burners and lamps, and such mantle maintenance schemes are pretty general throughout the country.

They are generally worked on one or the other of two plans. Under the first, the consumer contracts to pay a fixed quarterly or annual charge per burner for periodical overhauling and the supply of all materials. This work is generally undertaken at a loss, the charges covering little more than the cost of the materials supplied.

The other plan is for the undertaking to contract to send men periodically to examine and clean the burners, globes, &c., making no charge for the labour but invoicing all materials supplied at something above cost.

The second plan is more favoured by consumers in private houses, where a good many burners are only in very occasional use; but for business premises it has the disadvantage that it leaves the decision as to whether mantles shall or shall not be renewed too much to the consumer who may sacrifice efficiency to economy, with the result that his premises are a bad advertisement for gas lighting; whereas under the first plan the expense of putting on sufficient mantles to keep the lighting in first-rate order falls upon the gas undertaking, whose obvious interest is to see that the consumer gets the very best light for the gas consumed.

The necessity for the maintenance of gas cooking and heating appliances is perhaps not quite so generally recognised as the need for mantle maintenance, though it is really just as important. Every gas cooking and heating stove should be periodically examined and, where necessary, put in working order, as many gas consumers do not recognise when a gas appliance is out of adjustment and put up with unsatisfactory results which create a wrong impression in their minds and in those of others. It is to be remembered that it is even more important to retain and consolidate old business than to obtain additional business, and that the former makes the latter an easier task.

Some undertakings in this country (and the number is steadily increasing) have fully realised this and have established a system for the periodical inspection and adjustment of all their consumers' gas appliances. Generally no charge is made for this service except so far as the supply of new parts is concerned. In the case of apparatus on hire, the necessary parts for repair are, of course, supplied free of charge.

We have no doubt that this work will bear good fruit in the future and that, as time goes on, the number of men actively interested in the scientific utilisation of gas for illumination will steadily increase.

The concluding portion of Mr. Goodenough's paper contains an account of the well-organised work of the British Commercial Gas Association. Although, needless to say, much of this educational work is familiar to readers of this Journal, it is useful for us in this country to take stock, from time to time, of the steady progress being made in the education of the consumer, and the account given by Mr. Goodenough of this work must have been particularly interesting to gas engineers in the United States.

## LIGHTING RESTRICTIONS AND COAL DELIVERIES.

LIGHTING restrictions are having some unlooked-for effects. At a recent conference in Edinburgh between the Corporation and the coal merchants, it was pointed out by the latter that in the absence of any public lights on the dark mornings the delivery of coals was a serious matter, and unless something could be done to help them, deliveries would have to be deferred until daylight. They suggested that the public electric lamps might be put on at 6 a.m. during the dark season. The Electric Lighting Committee have agreed to recommend the Town Council to light the lamps in the main thoroughfares as suggested. Also, the St. Pancras Borough Council suggest that the rate collectors shall not keep their offices open at night, owing to the dangers of the streets and the risk in the transit of money received during the evening.—*The Gas World*, 30th October, 1915.

## ILLUMINATING ENGINEERING IN GERMANY.

SINCE the commencement of war readers have doubtless wondered occasionally what is the state of the lighting industry in Germany, and whether the technical and scientific work of the country is being carried on as usual. So far as can be gathered from the technical papers lighting arrangements have not been greatly interfered with, although the depletion of the staffs of electric supply companies has been a difficulty. One would also imagine that the comprehensive arrangements for the commandeering metals and other materials for war purposes must have had a pronounced restrictive effect on trade.

It is stated that the shortage of petroleum in Germany, where oil is very largely used for lighting among the poorer classes, has even had the effect of stimulating electric lighting. The manufacture of electric torches has also increased very rapidly owing to the demands of the German army, and it is inferred from the large number sent to neutral countries that some of them also find their way into the armies of the allies!

We notice that a number of papers of a scientific and technical character have been read before the German Illuminating Engineering Society. The subjects for discussion resembled in the main those in other countries. In our August issue, for example, we noticed a paper by Lux dealing with the photographic action of various artificial illuminants, and there has been some discussion on the use of half-watt lamps for portraiture by artificial light—a subject which has recently been dealt with by the Illuminating Engineering Society in the United States.

Among other papers we notice a contribution by Bloch on the definition of the colours of surfaces in terms of the primary colours; the reflecting power for red, green, and blue light being suggested as a possible criterion. Herr v. Pirani gives an account of a new method of heterochromatic photometry, which has been noticed elsewhere in this Journal.* Bechstein summarises the results of a series of photometric tests on the agreement of various observers when comparing white and heterochromatic lights. These observers were novices in photometry, but even so the variations seem considerable.

Perhaps the most interesting item, however, is the discussion of the paper before the Elektrotechnischer Verein by Dr. Salamon, on the photometry and marking of electric lamps—a subject with which we, in this country, have been recently occupied. The author gave a series of polar curves from lamps having various forms of filaments, drawing the conclusion that the only rational method of estimating the light is in terms of mean spherical candle-power. He also advocated that the consumption in watts should be marked on the lamps. On this point there was much discussion, some speakers expressing the view that mean spherical candle-power should also be indicated. Professor Wedding showed himself again a strong advocate of mean spherical candle-power, pointing out that in these days it is possible to alter the distribution of light from a lamp very widely by means of appropriate globes and reflectors, and that it is often necessary to modify considerably the direction of light from one and the same lamp, according to the purpose for which it is used. Professor Wedding wished to apply this basis of comparison to all illuminants, and not only to glow lamps, and he added that

* Sept. 1915, p. 393.

recent experiments on the Ulbricht globe had demonstrated the utility of this apparatus for measurements of spherical candle-power.

Some speakers were in favour of only marking the watts on the sockets of lamps, but advocated the giving of full data regarding candle-power and distribution of light in catalogues and price lists. Others, however, wanted to mark on the lamps much fuller information, including P.D., watts, efficiency, and mean lower hemispherical candle-power. Dr. Bloch agreed in principle that mean spherical candle-power was now the correct method of comparing the candle-power of lamps, and theoretically should be applied to all illuminants. Nevertheless, he had come to the conclusion that it would not be acceptable to makers of arc lamps, and thought that it would be necessary to make a start with glow lamps first. He also considered that from a practical standpoint it was desirable to mark lamps with the watts, and pointed out that at the present time, when lamps consuming 1 watt per H.K. were in general use, it was a convenient moment to take this step. He suggested also that in view of this fact there should be a reversion to the more scientific method of expressing efficiency in "candle-power per watt."

Prof. Wedding, in the remarks quoted above, had referred to the experiments of the Lichtmesskommission of the Verband deutscher Elektrotechniker on the use of the Ulbricht globe. These experiments are summarised in an article by Utzinger, who gives precise particulars for the coating of the interiors of such apparatus. He proposes two distinct coatings, one to form the permanent ground work, the other, consisting mainly of zinc white, to be superimposed over it and preferably renewed every year.

## ILLUMINATING ENGINEERING IN AUSTRALIA.

WE notice with interest a lecture on artificial lighting which was recently delivered by Mr. V. H. Mackinney before the Electrical Association of Australia (N.S.W. Section).* The ground covered in the paper is familiar to readers of the ILLUMINATING ENGINEER. Mr. Mackinney gave some examples of the value of good lighting in connection with the care of health, and as a safeguard against accidents. He summarised the general points to be attended to in order to give a pleasing and comfortable impression to the eye, and he showed a number of illustrations which had previously been brought before the Illuminating Engineering Society in this country; these included some of the pictures of shadow effects for which the author was responsible in connection with Mr. J. S. Dow and Mr. J. G. Clark. A special section of the paper deals with the control of light and the application of suitable forms of globes and reflectors to artistic designs of fixtures.

We are glad to see that in spite of the distraction of the war, illumination is being studied in Australia; no doubt when peace is restored there will be opportunities for considerable development in this country.

## A UNIQUE MOVING PICTURE EQUIPMENT.

IN *Popular Mechanics* (August, 1915) there is an account of a special moving picture installation now being used in the Chicago amusement parks which enables pictures to be shown in the open at night without being interfered with by the glare of the numerous incandescent lamps and arcs used to illuminate the grounds.

The picture is projected from a distance of 186 feet on a specially chemically prepared translucent screen. The projector is behind the screen, so that the picture is seen by transmitted light. In this way a much brighter picture is obtained. The only screening consists of a series of radiating black curtains near the sheet, which do not interfere at all with the view of the audience seated in the open.

* Reproduced in *The Salon*, the official organ of the Institute of Architects of New South Wales, Queensland, South Australia, West Australia, and Tasmania, April, 1915.

## A NEW FORM OF FLICKER PHOTOMETER.

THE comparative advantages of Equality of Brightness and Flicker Photometers have been much debated, and there is much to be said for an instrument capable of utilising either of these principles. H. F. Kingsbury has devised an attachment enabling the Lummer-Brodhun photometer to be used as a flicker instrument. The observer looks at the photometric field through a small aperture subtending about 2° at the eye. (This size of aperture is selected because —according to Ives—if the field subtends this angle and the illumination of the photometer screen has the convenient value of about 25 metre-candles, flicker and equality of brightness photometers give the same result.)

By means of a rotating prism in the observation tube the two illuminated surfaces in the photometric field are brought successively in front of the aperture, so that a flicker results. In this way we make use of the very fine line of division between the photometric surfaces characteristic of the Lummer-Brodhun photometer. A very sensitive arrangement is thus secured.

One interesting refinement mentioned by the author is the illumination of the eyepiece, which has a whitened interior, by means of a small concealed glow lamp. In this way a luminous area surrounding the photometric aperture, having the same degree of brightness, is secured. It is suggested that this has a more satisfactory and less fatiguing effect on the eye than the usual contrast between the bright luminous field and the dark tube around it.

The problem seems to be somewhat similar to that encountered in rifle range lighting, where the severe contrast between the brightly illuminated target and the very dark surroundings was found to be sometimes unfavourable to acute vision.

## THE IMPORTANCE OF BACKGROUND IN THE OPERATING THEATRE.

AN interesting point in connection with the design of Operating Theatres was raised in a recent letter to the *Lancet* by Sir Berkeley Moynihan, Head Surgeon to the Leeds Infirmary. To the illuminating engineer the importance of careful design of the lighting arrangements in an operating theatre is evident; it is essential that the principle of "light on the object and not in the eye" should be followed and that there should be no tendency to glare through exposed lights.

Sir Berkeley's letter, which we reproduce below, shows that the nature of the background may also have a decided influence on the operator, and that if the surroundings are too light they may give rise to a species of glare which it is desirable to avoid:—

SIR,

It has long been the custom of surgeons to use white sterile towels or sheets around the area upon which an operation is to be done. There are many disadvantages in the use of white. A large expanse of white, especially when the sun is shining, is wearisome to the eye and causes fatigue, and it detracts from the value of the light upon and within the wound. It is not sufficiently realised that good illumination is not needed, except upon the part which is concerned in the operation. Light should be concentrated upon the wound and not widely diffused. For the last two years and a half I have used towels and sheets of green colour instead of white. Green is a restful colour, offers no sharp contrast to the colours of the wound surfaces, and allows ligatures and sutures to be clearly seen against it. I have tried black towels, but the change from black to other colours in an operation theatre is sudden and trying, and ligatures do not stand out clearly against such a background. I have painted the walls of my operation theatre green, and have a green coloured material on the floor. The great relief to the eyes which results from the use of a green material round the wound is remarkable. The ordinary green "casement cloth" from which my towels and sheets are made is of good colour, retains its colour on washing and sterilising, is easily obtained and is cheap.

I am, Sir, yours faithfully,

(Signed) BERKELEY MOYNIHAN.

## NOTES ON LONDON'S LIGHTING DURING THE WAR.

SINCE the diminished lighting of London came into force there have been many interesting and occasionally amusing references to the subject in the press. Few days pass without one noting some mention of lighting. The changes have certainly done a great deal to interest the public in street illumination—and, we may hope, to convey some lessons which will be acted upon when once we return to normal conditions.

### Whitened Kerbs—and Constables.

In the last issue of this journal the most recent Lighting Order was summarised. Reference was made to the practical suggestion that the kerbs and street refuges should be whitened. The steps taken in this respect have already been of considerable assistance to those groping their way home in the gloom.

According to the latest news, it appears that not only stationary obstacles, but moving animate ones, are also to be whitened. In future constables on point duty will wear a broad white band above the left cuff. This, no doubt, will make the uplifted arm more visible. The method is curiously similar to one adopted in America, and described in the last issue of THE ILLUMINATING ENGINEER.

It goes without saying that the changes have had a marked effect on the life of London. People stay at home to a much greater extent, and it is said that a "national campaign" to popularise reading is to be instituted. Meantime churches are considering the advisability of discontinuing evening service, and this step has already been announced at St. Paul's. Leading shops are also to close earlier, in some cases at 5 o'clock.

The condition of the streets by night has been the subject of recent discussion, both in the House of Lords and in the House of Commons. Sir William Byles is reported to have expressed the hope that late sittings of the House would be restricted. "Some of them (the members) were getting old and deaf and partially blind, and the condition of the streets now made it a dangerous operation for them to traverse them late at night."

### Illumination during a Fog.

Lord Sydenham, in the House of Lords, said that, with "respect to illumination he thought we had gone perhaps a little further than was necessary in the direction of darkening our streets. If the illumination were kept low enough to prevent the identification of special objects, that was as low as it was necessary to go." Moreover, flashlight signals from possible enemies in our midst were rendered easier if the illumination were diminished beyond a certain point.

The difficulties of traversing the streets were made still more evident during a recent fog, and on this point also Lord Sydenham had something to say. He thought that when fogs occurred temporary lighting measures, at any rate in the main thoroughfares, should be provided. Lord Curzon, in reply, indicated that arrangements had been made to turn on, in foggy weather, a number of lights which were not used on clear nights. Another step to be taken was the provision of flares at important points of traffic.

### Special Speed Limit for Motor Vehicles ?

There has also been much discussion on the desirability of imposing a special speed limit for vehicles. This matter came before the London County Council, but it appeared the Act contains no provision for imposing such a limit within certain hours only; on the other hand, the imposition of the limit at dangerous crossings and important stopping places at all hours would be difficult to enforce, and could only be obtained by application to the Local Government Board.

Meantime accidents ascribed to the reduced lighting continue to occur. Take, for example, in a recent inquest at East Ham on a cyclist who collided with a taxicab. The jury, in returning a verdict of accidental death, said it was mainly due to reduced lighting, and the Coroner said that the man had been sacrificed to the needs of the war in the same way as others had been sacrificed at the front. A motor-bus accident, which occurred shortly before midnight in Westminster Bridge Road on November 7th, and resulted in the death of one man and the injury of two others, may

also have been due to the present conditions, as the street was stated to be very dark at the time.

### Wanted—A Definition of "A Bright Light."

Drivers are still faced by the problem of deciding what constitutes an unduly bright lamp. An amusing incident is narrated in the *Evening News* for November 1st:—

A motorist was stopped by a "special," and the following monologue took place:—

"Your light's too powerful. I shall have to report you. I don't want any arguments. . . . Where's your license? . . . Thank you. What's the name on it? (Attempts to read license by light of offending lamp). . . . *'Er—just turn that light up a bit, will you!*"

The problem likewise occurs in connection with the regulations for screening lamps in shops and houses, and there seem to be remarkable variations in the fines inflicted for this offence in different neighbourhoods. Perhaps the most remarkable among the definitions of a bright light furnished by the war is that given by a magistrate in the case of a costermonger, summoned at the South Western Police Court for not subduing the bright lights of his whelk stall.

Defendant wanted to know what a bright light was.

"A bright light," said the magistrate, "is a light that is bright. It is a relative term."

We can scarcely hope that the poor costermonger felt much enlightened.

## CORRESPONDENCE.

### DIMINISHED STREET LIGHTING AND MOTOR TRAFFIC.

18th October, 1915.

SIR,

Now that our streets are so exceedingly dark at night, may I be permitted, through your columns, to beg pedestrians, for their own safety, not to walk along in the roadway, so long as there is a reasonably good path alongside which they can use?

I am a motor-cyclist, engaged on Government work at Woolwich, and every night in the course of my 6-mile journey home I pass a considerable number of people walking along in the roadway, quite regardless of the fact that they cannot be seen by approaching traffic. It would appear to be a prevalent idea among pedestrians, who probably have not seriously considered the matter, that a motorist's lamps still enable him to see objects some way ahead of him; but I would point out that this is not the case at the present time, no matter how slowly he may be travelling. Khaki is especially difficult to see at night.

Driving home every night through almost unlighted streets, after long hours at work, is already quite enough strain for one's nerves, without the added danger of unlighted pedestrians walking along in the road. If a man specially desire to walk in the road, I should suggest that he carry in his hand something white, such as a paper or a handkerchief; though even this would be almost invisible, it would be better than nothing at all.

May I also appeal to drivers of vehicles of all kinds, horsed ones especially, to have lamps on *both* sides in front, with a *separate* red lamp at the rear? The usual off-side lamp with a red glass at the back is quite invisible from behind, if the road curve slightly to the left; in many cases, too, such a light is obscured by the rim of the wheel or by an overhanging load, though technically a red light is there. At a cross-roads, if only the one front lamp be carried, a vehicle is quite invisible to any one approaching from the driver's left. Further, lamps on vehicles should be placed at a reasonable height only, as on a car or taxicab. One frequently meets vans or lorries with their lamps placed very high up—motor-'buses also being great offenders in this respect—with the result that unless one be on a very familiar road, it is very easy at a distance to mistake their lights for those of street lamps.

Yours, &c.,

A MEMBER OF THE
ILLUMINATING ENGINEERING SOCIETY.

# SOME NOTES ON LIBRARY LIGHTING.

By ALEX. J. PHILIP.

(Editor of the *Librarian and Book World.*)

A CERTAIN looseness is to be observed in the general use of terms in lighting, although a degree of standardisation is being adopted gradually. Where those discussing the subject are experts this does not matter very much, because, even if the misconception is not admitted, the one very quickly sees what the other understands by the term. This is not the case in general, and for this reason the terms "point," "general," "reflected," "diffused" will be defined in their use here during the progress of the paper.

"Point" is the point at which the light is thrown. There may be several lamps at that point, which would be described as a cluster. The "point" in wiring is the spot at which the wires emerge or are fixed. From this has grown up—in libraries—a slightly different use of the term, due entirely to the somewhat peculiar conditions of arrangement, but the term when analysed, is exactly the same in meaning. This can be best explained by describing the point lighting of a quadruple newspaper stand. The wires emerge from the floor at one point and are carried up a leg of the stand; there they are divided into four points, or individual lamps: *i.e.*, one over each newspaper on the stand. This is in no sense a cluster as there is a space of from 2 to 3 feet between each lamp. There is much to be said in favour of point lighting: and in certain departments of public libraries it is almost essential. Purely point lighting has the disadvantage that above the eye-line the light in the room is dim, unless the number of lamps is very large and the shades are transparent: under these conditions many of the features of combined point and general illumination are to be found. And here it may be said that in general point lighting for public institutions must be used in con junction with some other system.

General lighting, from the library point of view may be described as a distribution of light by means of arc lamps, single powerful wire lamps, or clusters of lamps, at a height greater than that of any possible eye-line, and without either concentration or diffusion of light. It may be said at once that this method has very little to recommend it for either libraries, museums or art galleries, except its economy and from the standpoint that it "looks nice" from outside. On the other hand a small amount of general illumination combined with point lighting may be made to yield excellent results.

Reflected light consists, in principle, of throwing a strong shaded light on to a large white surface such as the ceiling or the upper parts of the walls. The light that is thrown back or reflected—sometimes called diffused—is soft and evenly distributed. It is, undoubtedly, the nearest approach to natural light. It is not particularly adapted to book stacks; and is, moreover, very expensive when compared with, say, general illumination. But for art gallery, and museum work, and for most departments of library work it is unsurpassed.

The impossibility, on the score of expense, of installing reflected light, has brought into vogue the system known as diffused light. This may be best described as a combination of "general" and "reflected" systems. One big lamp, or a cluster of smaller lamps set in a shallow shaded, or ground, or frosted glass bowl throws beams on to the ceiling and from the ceiling downwards. If the ceiling does not offer a suitable reflecting surface a reflector is arranged over the bowl.

A public library presents more problems in lighting than any other library, and in dealing with the problems of a public library most of the difficulties experienced in private and institutional libraries are met with.

The lighting of the Reference Library presents many special difficulties, largely because there are various eye-lines. This is the result of placing tables and

bookcases in the same room. Without the bookcases the room becomes a reading room: without the tables it is a bookstore. As a rule some of the bookcases are open for the use of the public; while others contain books to be obtained only on application, but are so shelved, that the public are not only able, but expected, to read the titles on the backs. These bookcases are usually from 7 to 8 feet in height. The line of vision may be therefore nearly 8 feet from the floor, while the eye-line on the tables may be as low as 3 feet 6 inches. The bookcases and tables are usually dark in colour; more often they line the wall, less frequently they project at right angles. Under these circumstances the best system has been found to be a system of diffused lighting supplemented by small candlepower lamps for point lighting. The advantages are still more marked where students' tables are in use. The table lamps may or may not be arranged for switching on and off by the reader. The fascination of table switches in many cases is only that of a toy. Their use is a confession that the reference library is not expected to be much used. Where table switches are installed there must be sufficient light not controlled by the readers. The British Museum is often cited as an example of the value of the table switch; but the British Museum is almost unique in the enormous height of the dome and the distance of the arc lamps from the floor; as well as in the class of reader using the room. Under no circumstances should one light or a single switch serve two readers. If the bookcases in the reference room are low in height and few in number they may be illuminated with point lights also.

In point lighting particularly a great deal depends upon the shades. Since the introduction of the long metal filament lamp shades have not changed sufficiently in size and shape. On the eye-line nothing of the naked lamp should be visible. Many of the cup-shaped shades are not deep enough to prevent the rays from the lamp shining directly into the eyes of the reader. One of the most useful shades in a library is the inverted cone shape of 6 or 6½ inches deep and 10 inches in diameter. The reason for this is to be found in the greater radius of the effective beams of light without the lamp itself becoming visible. The height of the lamp from the table is determined by the size of the table and the power of the lamp. It is a *sine qua non* that the shade contains the whole of the lamp. The question of standard versus drop lights over tables is determined in general by the size of the table. Small, and single tables, may be fitted with standards because the circle of the reading surface can be covered by the reflecting shade a short distance above. If the table is bigger than the circle of effective light two lamps must be used if standards are insisted upon. There are several disadvantages in the use of table standards, but, perhaps, the most important is that a considerable amount of light is wasted because the rays of both lamps are thrown on the same surface near the centre, and that section is not used for reading purposes. If the standard is high enough to do away with this objection the danger of the direct rays being thrown into the eyes of the reader becomes very great. The drop light, however, can be 3 feet 6 inches above the table reading surface; a height sufficient to remove the danger of direct rays at the seated eye-line level. The circle of effective light from the reflector-shade described is 7 feet. This must be qualified by the lighting power of the lamp. The higher the lamp the greater the radius of light and the lower the illumination. It will be seen, too, that the illumination is less at the outer edge of the circle than at the centre. To put the statement in every-day terms: a 50-watt lamp in a deep opal shade 10 inches by 6½ inches, raised 3 feet 6 inches above the reading surface will throw quite sufficient light on a circle 7 feet in diameter, in conjunction with moderate general or diffused lighting. But by continued experiment it has been found that opal shades used for point lighting allow sufficient light to pass upwards to satisfy the needs of general illumination—if they are in sufficient numbers. In this way all the advantages of point lighting are secured with many of the more prominent advantages of diffused and general lighting at a minimum cost.

These remarks regarding table lighting apply equally to all the reading rooms of a public library.

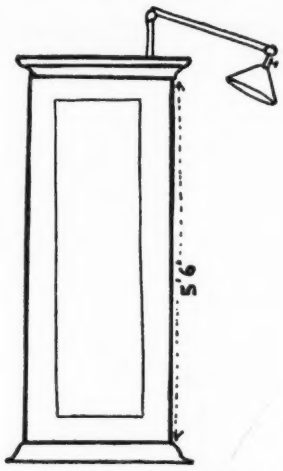



FIG. 1.—Point light for low single bookcase in adjustable holder.

Point lights for low single bookcases should be fixed in adjustable holders. These are to be obtained with any number of joints, but it is seldom that more than three are required. If the bookcases are tall the difficulty of lighting them is much greater; as in the ideal system the lower shelves will be as well lighted as the upper. The more ordinary problem in the extraordinary class is to light bookcases 9 or 10 feet high in a public reference room. These high bookcases are seldom found in lending libraries because the constant demand for books makes their use prohibitive. The ordinary drop light will not illuminate a bookcase of this height sufficiently for public or semi-public use. The farther out and the lower the lamp the less illumination there is on the upper shelves: the nearer and higher it is—to throw on to the upper shelves—the less light there is on the lower shelves. Many plans suggest themselves, but in most cases the reader or user throws his own shadow on to the books. The proposal to place white drugget or similar material on the floor between the cases loses sight of the fact that any such floor covering will become dirty in a few minutes in an open-access library. Troughs for lights at the foot of the bookcases are open to the insuperable objection that, if the trough is near enough the case to avoid the would-be reader the light is thrown upwards, while if the trough is brought forward, the light is obscured by the readers' boots and clothes. There are still more serious objections to the raised reflector or step at the foot of the bookcases in certain libraries: quite apart from the fact that the continuous step is now rarely met with.

It is not necessary to go into the details of the objections to various schemes; it will be sufficient to describe the method that best solves the problem of the 9 feet bookcase. The very tall bookcase is seldom seen in lending libraries, but the remarks already given refer equally to the lending library where the lighting problem is the same. The special problem of the lending library is in two parts: (1) as an "open-access" library; (2) as a closed library. The lighting in the first case must be much more effective than in the second, although this is not to say that the lighting in the second may be defective. A 50-watt lamp in a shade the size already described hung at the level of the top of the books or the top shelf mid-way between the two cases will be found to throw enough light on both sides of the gangway for a distance of 3 feet on either side, to satisfy the conditions of (2). I quote these shades

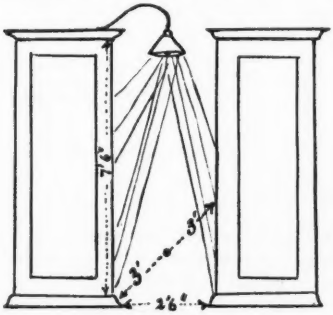



FIG. 2.—Lighting bookcases in a "closed" library.

because they are a definite standard giving certain universal results except for local variations, but other designs may be

used giving brighter or softer lights; or contracted or extended reflection.

In a "closed" library (2) local switches are recommended.

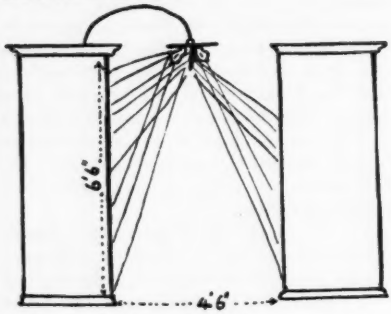



FIG. 3.—Small c.p. lamps for open-access libraries.

We come now to the "open-access" library. The bookcases here are not more than 6 feet 6 inches high, nor less than 3 feet 6 inches apart. The arrangement of lamps suitable for the tall bookcases is quite unsatisfactory here. The body of the reader must always interpose between the light and the books. The use of double lamps of small power, say 30-watt or 50-watt, and reflectors of the shape shown in the sketch below, or some shape equally suitable will go a long way towards solving the problem. If economy is essential the following shape may be used; but the result is not so satisfactory. The shade-reflectors may be of porcelain or white enamelled metal.

FIG. 4.
Bare lamp.

FIG. 4A.
Suggested form of shade.

Another method, successful so far as lighting is concerned, has the drawback that the light is thrown into the eyes of the readers at certain angles, although this evil may be reduced by using frosted bulbs: in a double bookcase the lights, small in power, are shown in box reflectors at alternate corners; the lamps on the bookcases opposite would be reversed in position. The principle of this is that each case is lighted from the case opposite.

The most difficult section of the closed library is that containing the Indicators. These present a flat perpendicular glazed surface on the one side, and a similar surface on the other, unglazed. They are about 3 feet 6 inches high and about 3 inches thick, although a wooden frame increases the thickness considerably. Drop lights are a failure. The only satisfactory method so far is to use fixed standards with adjustable joints. Lamps on the glazed side should not be very powerful on account of the reflecting surface, and they should not be more than 4 feet apart.

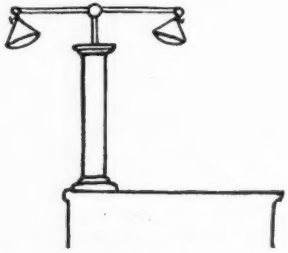


FIG. 5.—Adjustable lamps over an indicator.

Catalogue tables, slopes, or stands, and card catalogues are so infinite in variety that it is extremely difficult if not quite impossible to deal with the subject satisfactorily in a few words. If efficient diffused or reflected light is provided no further special treatment will be required in most cases. Owing to the peculiar conditions governing many forms of slope and stand for catalogues the drop light is seldom entirely successful, except in such circumstances as are to be found in the British Museum, where the catalogue cases would be governed by the remarks already made on table lighting. The simple wall slope, however, that is to be found in some libraries, should have the lights arranged at the back, a few inches above the catalogues, set length-ways in long reflectors.

The combination of news-room and reading-room generally results in misfortune if an endeavour is made to make one system of lighting satisfy the requirements of both. This is shown in the following figure. The maximum light

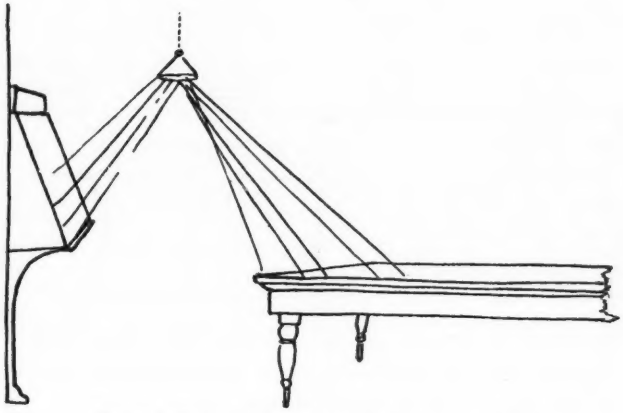


FIG. 6.—The maximum light is thrown on the floor.

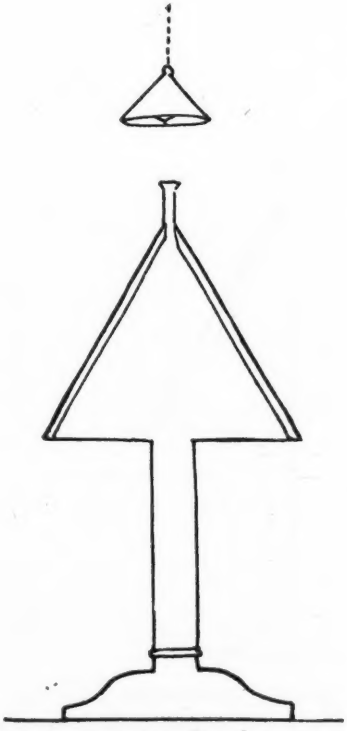


FIG. 7.—The light in this case is wasted and badly distributed.

FIG. 8.—The reader here throws his own shadow on the paper.

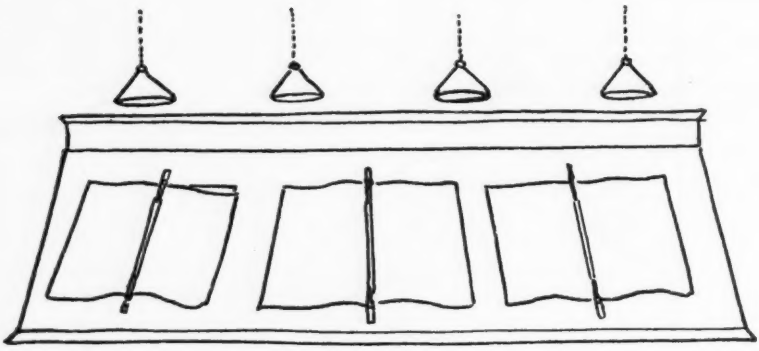


FIG. 9.—The maximum light in this case is thrown on to the stand, not on the paper.

FIG. 10.—The circle of light is too small and too concentrated.

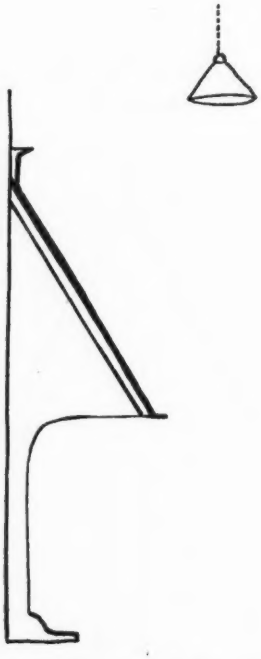


FIG. 11.—The upper part of the paper is in the shade.

is thrown on the floor. The needs of both news-stands and reading tables must be considered separately. Tables have been dealt with already. The newspaper stand or "slope" presents a surface at an angle of from 50° to 60°. The type is small, as a rule, and several persons may be using the paper at the same time. On the other hand if each paper has its own light the surface to be illuminated is not more than 5 feet by 3 feet. Figs. 7 to 11 show arrangements to which serious objections can be urged.

Long experiment has shown that the method of Fig. 12 is the most successful for the following reasons:

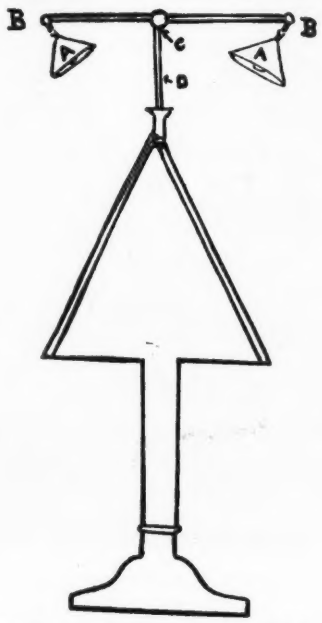



FIG. 12.—An effective method of lighting newspaper stands.

direct rays cannot shine in the eyes of the reader; the reader cannot intercept the light; low candlepower lamps may be used as the maximum illumination is on the paper; the whole of the newspaper is illuminated.

A.A. are the shades 10 inches by 6½ inches already described (the size is the important point).

B.B. Adjustable ball socket with thumb screw.

C. Centre tube in an outer tube, fixed with a thumb screw.

D. Tube in which "C" works up and down.

The variation of height is a maximum of 18 inches. The whole revolves when desired. And the lamp can be adjusted at any angle for large or small periodicals.

In the lecture hall, now attached to so many libraries, a form of reflected or diffused light is to be recommended. In view of the fact that at some time or another the hall is likely to be used for exhibitions — photographs, pictures, museum objects, or business appliances— this might be described as almost essential, because no system of point lighting could be devised capable of being adapted to the varying conditions of miscellaneous exhibitions. If the use of the hall is to be strictly limited to lectures, "general" illumination may be adopted. The arrangement of the light points and switchboard should be governed by the lantern lecture, *i.e.*, by the need for controlling all the room lights from one board, with alternating switches for certain lights at the doors, with an individual switch for the lecturer, and an independent switch for the lantern. The staff room, workroom, and committee or boardroom do not present many special problems other than those to be met with in houses of business everywhere; the same applies to the librarian's office.

The librarian's office and the committee room should offer no difficulty to the introduction of diffused or reflected light, although the former should have a drop light with a counter-weight for minute scrutiny of doubtful material or microscopic examination. From the desk it should be possible to control all the lights in the office by alternative switches. In store rooms it is a good plan to have a minimum number of fixed lights with plenty of movable lamps. If the work room is extensive and used for book-binding, repairing, printing, mounting, cataloguing, classifying, &c., each part of the room must be treated according to the work to be done there.

## PROFESSOR VIVIAN B. LEWES.

BORN 1851—DIED 1915.

IN the death of Professor Vivian B. Lewes, who passed away on October 23rd, the gas industry has lost one of its leading exponents. Professor Lewes was a man of varied scientific attainments, and for half a century had been associated with applied chemistry, particularly in relation to the industrial uses of gas and oil fuel.

His first appointment, in 1879, was as assistant to Prof. Williamson, the chief gas examiner in the Metropolis. Subsequently he became Professor of Chemistry at the Royal Naval College, Greenwich, a post which he filled until a few years before his death. In 1892 he was also appointed superintending gas examiner for the City of London. His active mind interested itself in many varied controversies of the day, and he contributed many papers to scientific societies.

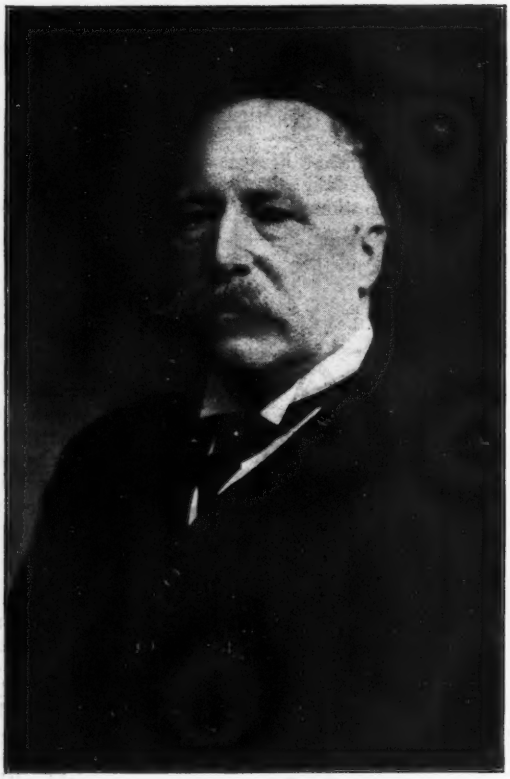


*Photo by Elliot & Fry. For the use of this block we are indebted to the courtesy of the "Journal of Gaslighting."*

It was, however, as a lecturer that Professor Lewes found his special sphere. He had a remarkable gift of clear explanation and never failed to interest his audience, often driving home his point by apt illustration and humorous anecdote. Probably few lecturers of our time have spoken on such a variety of platforms, but his discourses before the Royal Society of Arts were perhaps the most widely known. His celebrated series of Cantor lectures on Acetylene, from which afterwards came his book on this subject, and on the Incandescent Mantle, were of European reputation and are still widely quoted.

Throughout his life Professor Lewes took a great interest in lighting matters and delivered many popular lectures on this subject. He was one of the original Vice-Presidents of the Illuminating Engineering Society. Shortly after the commencement of war he became Chairman of the Chemical Section of the Inventions Department of the Ministry of Munitions, and but a few weeks ago lectured on Explosives before a crowded audience at the Royal Society of Arts.

His death will be keenly regretted by many friends in this and other countries.

# TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

## OSRAM PAINTING BOOKS.

**The General Electric Co., Ltd.,** have certainly struck a novel and enterprising method of advertising in their "Osram painting-books" for children. Throughout there are coloured pictures on the right-hand side and corresponding line pictures to be filled in on the left. The first of the series of three books before us deals with the lights of 1830, 1890, and 1915—candle, gas, and electric light. Another book deals with the illuminating engineering efforts among the Eskimos, the incidents being illustrated by quaint pictures in the orthodox picture-book style, and simple verses. On the cover there are some sound hints to aspiring young artists, while parents are advised to use Osram lamps!

## SIEMENS CONTRACT.

Messrs. Siemens Bros. Dynamo Works, Ltd., inform us that they have received an acceptance of a tender for the supply of Wotan lamps to the G.P.O. for the ensuing six months.

## THE WOTAN METAL DESK PAD.

We have received a specimen of the simple and ingenious Wotan desk pad, which acts both as a letter-weight and as a tablet for memoranda. The pad is provided with a spring clip so that any sheet can be readily detached or replaced as occasion requires.

## PORCH LIGHTING.

More than once in this Journal reference has been made to the problem of lighting the porches of private residences, so as to show up the steps at night and enable visitors to depart without the risk of a fall.

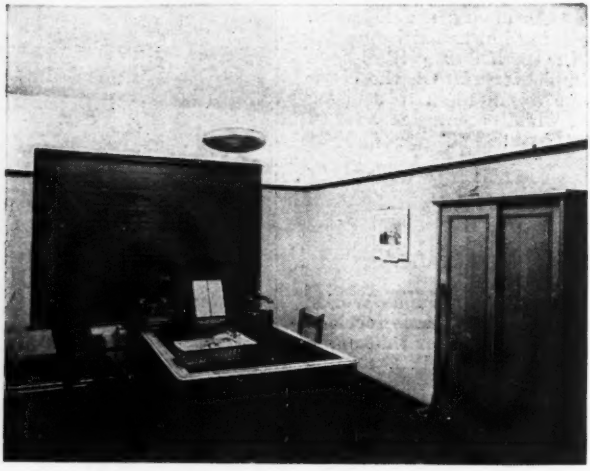
The adjacent illustration shows a case in which the chief requirements seem to have been met. The stairs are lighted by a lamp in a Holophane Bowl, mounted on the ceiling of the porch, so as to be outside the direct range of vision and to throw the light down on the stairs.

It will also be noted that the pillars are shown up in strong relief, and the general effect is quite pleasing.

## THE LIGHTING OF WEST AFRICAN HOUSE, KINGSWAY.

View of the general office lighting, West African House, Kingsway.

The chains suspended from the fittings are used to actuate the three-way switches.

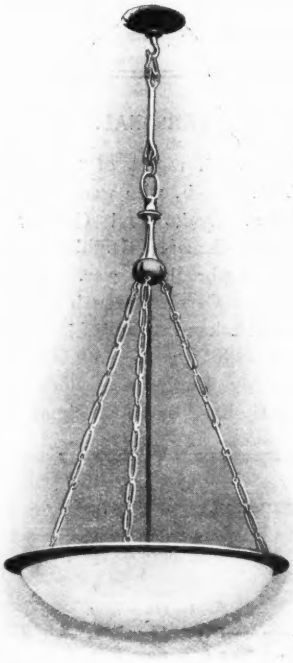


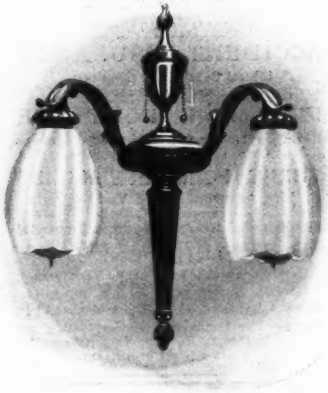
Agent's Office, West African House, Kingsway.

Above are two examples of the British Thomson-Houston's Company's "Eye-Rest" indirect lighting system as installed at the new West African House, Kingsway, which utilises some 120 "Eye-Rest" fittings. Attention is drawn to the excellence of the diffusion of light and its restful effect on the eyes.

## EDISWAN ARTISTIC LIGHT FITTINGS.

The New Ediswan Catalogue of Artistic Light Fittings (Section VI.) is now to hand. It covers all the usual range of units employed for interior and domestic lighting, hall lanterns, pendants and ceiling fittings, table standards, piano and reading lamps, &c.





The most striking sections are, perhaps, those on ornamental brackets and semi-indirect fittings. The latter are unusually complete, and we notice that the effective method of presenting these fixtures with a black background, is adopted. We reproduce two blocks showing respectively typical semi-indirect and bracket units.

Two graceful designs of Newell Pillars also deserve mention.

## THE LIGHTING BOOKLET.

We have received from the Holophane Works of the General Electric Co., of Cleveland, Ohio, a copy of the "Lighting Handbook"—a little publication giving much information in a condensed form, Besides the usual definitions of lighting units, and tables of illumination required for various purposes, we notice some tables illustrating the appropriate spacing of indirect and semi-indirect units—which is less well known than the corresponding particulars for direct lighting. Speaking generally, indirect and semi-indirect units may be spaced at a distance apart equal to $1\frac{1}{2}$—2 times their height, according to the size of the room for general lighting; and at distances apart equal to ·5—1 times their height if a strong illumination for detail work is aimed at.

Various problems in lighting are briefly dealt with, and in conclusion the polar curves and data for a representative series of units are given.

## REVIEW OF BOOK.

*Jena Glass and its Scientific and Industrial Applications. By Dr. H. Hovestadt; translated by J. D. and A. Everett. (Macmillan & Co., London and New York. 1902. 419 pp.)*

THERE has probably never been a time when the people of this country were more ready to appreciate the value of science in industry; and one could scarcely select a better example of highly-specialised applied science than the glass works at Jena, whose development is described in the introduction to the above volume. In this field, as in so many others, early enterprising efforts were made by individuals in England—for example, Harcourt's efforts extending from 1834 over half a century. But the scientific development of the glass-making really began with the researches of Abbe and Schott and their experimental work at Jena from 1882 onwards.

It is only possible to give a brief survey of the highly technical matters discussed in this volume. The headings of the chapters are as follows:—

I. Introduction; II. Optical properties of glass; III., IV., V. and VI., Perfecting of optical systems by the new glasses; the microscope, photographic objectives, telescopes, &c.; VII. Mechanical properties of glass; VIII. Thermal properties of glass; IX. After-working and thermometry; X. Chemical behaviour of glass surfaces; XI. Electric and magneto-optic properties of glass.

It is only necessary to glance over this list to appreciate the value to science of such work, as well as its industrial importance. Long years of research were necessary in order to produce series of glasses whose index of fraction, density, and dispersive power are accurately known, and which in addition have mechanical and chemical properties which render them specially adapted for various scientific instruments.

The book brings together information from many sources not readily available to the ordinary reader, and at the present moment the whole subject is one of vast importance, both to the optical and the lighting industry.

## PERSONAL.

WE learn with regret of the death of Mr. F. H. Gooch, who was on the staff of Messrs. Drake and Gorham, but joined the Cameron Highlanders soon after the outbreak of war. He fell in defending a German trench which our troops had taken in front of Vermelles.

Mr. Gooch was a member of the Illuminating Engineering Society, and was greatly liked by all who knew him.

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*Signature* .....

This Coupon must not be cut out, but left intact in THE ILLUMINATING ENGINEER as that being dated, forms the only evidence of its currency.

## LIGHTING OF A CHURCH IN WAR TIME.

We are indebted to the British Commercial Gas Association for the accompanying illustration, showing how the lighting of the church of All Saints', Maidstone, has been adapted to war conditions. At the present time the lighting of places of worship is often a rather troublesome problem. In view of the large window area exposed it is important to restrict the lighting so as to make the building inconspicuous to hostile aircraft—particularly at Maidstone, which, being in an eastern county, is decidedly within the war zone.

The expense of providing blinds for all the windows is, in most cases, a considerable item, and therefore it is desirable to meet the situation by the use of suitable shades. The church of All Saints' was formerly lit by eight standards in the nave, each carrying seven upright incandescent burners fitted with pink eye-screens; these illuminated the church brilliantly right up to the roof.

In order to comply with the regulations of the authorities, The Maidstone Gas Co. were compelled to modify this system. The standards were accordingly altered to carry three inverted burners with green glass shades, while the brackets on the wall directly under the window carry only one inverted burner fitted with a shade of aluminium.

The present method of lighting, while subdued and adapted to war conditions, is sufficient for the needs of worshippers. No light is visible from outside through the windows.

Lighting of All Saints' Church, Maidstone, in War Time.